What is claimed is:

1. A waveguide directional filter and/or combiner for filtering and combining radio frequency signals (RF), comprising:

a first rectangular waveguide section;

a first elliptic filter section, ported to said first rectangular waveguide section at a substantially perpendicular angle thereto, with a common electrical-signal axis thereto;

a second elliptic filter section, ported to said first rectangular waveguide section at a substantially perpendicular angle thereto and substantially parallel to said first elliptic filter section, with an electrical-signal axis parallel to that of said first elliptic filter section; and

a second rectangular waveguide section affixed to, ported to, and terminating said first and second elliptic filter sections.

2. The waveguide directional filter and/or combiner of claim 1, further comprising:

a first rectangular waveguide flange affixed to and terminating said first rectangular waveguide section on the end thereof proximal to said first waveguide filter section;

a second rectangular waveguide flange, affixed to and terminating said first rectangular waveguide on the end thereof proximal to said second waveguide filter section;

a third rectangular waveguide flange, affixed to and terminating said second rectangular waveguide section on the end thereof proximal to said first waveguide filter section; and

a fourth rectangular waveguide flange, affixed to and terminating said second rectangular waveguide section on the end thereof proximal to said second waveguide filter section.

3. The waveguide directional filter and/or combiner of claim 1, wherein said first rectangular waveguide section accepts RF for propagation through the waveguide directional filter and/or combiner.

4. The waveguide directional filter and/or combiner of claim 1, wherein said first elliptic filter section accepts, from said first rectangular waveguide, in-band RF aligned with its TE_{10} propagation axis, and rejects both out-of-phase in-band RF and all out-of-band RF.

5. The waveguide directional filter and/or combiner of claim 1, wherein said second elliptic filter section is so spaced from said first elliptic filter section as to accept in-band RF out of phase with respect to the in-band RF accepted by said first elliptic filter section.

6. The waveguide directional filter and/or combiner of claim 5, wherein said second elliptic filter section rejects out-of-band RF from said first rectangular waveguide.

7. The waveguide directional filter and/or combiner of claim 2, wherein said second rectangular waveguide flange forms a portal out which RF rejected by said first elliptic filter section and said second elliptic filter section may pass.

8. The waveguide directional filter and/or combiner of claim 1, wherein said second rectangular waveguide section forms a pathway along which RF from said first and second elliptic filter sections may propagate.

9. The waveguide directional filter and/or combiner of claim 1, wherein said second rectangular waveguide section forms a pathway along which RF from said third rectangular waveguide flange may propagate.

10. The waveguide directional filter and/or combiner of claim 2, wherein said fourth rectangular waveguide flange forms a portal out which RF from said first rectangular waveguide flange, propagated through said first elliptic filter section and said second elliptic filter section, and RF from said third rectangular waveguide flange, rejected by said first elliptic filter section and said second elliptic filter section, may pass.

11. The waveguide directional filter and/or combiner of claim 1, wherein said first elliptic filter section further comprises:

a first first-filter resonator receiving RF from said first rectangular waveguide section and passing the received RF to the next first-filter resonator;

a plurality of successive first-filter resonators, each receiving RF from the previous first-filter resonator and passing the received RF to the next first-filter resonator; and

a final first-filter resonator, receiving RF from the previous first-filter resonator and passing the received RF to the second rectangular waveguide section.

12. The waveguide directional filter and/or combiner of claim 11, wherein said first first-filter resonator further comprises:

a first-filter, first-resonator input baffle restricting propagation of RF from said first rectangular waveguide section into said first waveguide filter section;

a first-resonator iris in said first-filter baffle, permitting in-band RF energy in the frequency range of the waveguide directional filter and/or combiner, and oriented in the direction permitted by the aperture, to propagate into said first waveguide filter section;

a first-filter, first-resonator output baffle; and

a first-filter, first-resonator output iris in said first-filter, first-resonator output baffle, interacting with said first first-filter, first-resonator input baffle, said first-filter, first first-resonator input iris, a set of first-filter, first-resonator tuning probes, and a cavity structure of said first waveguide filter section to form a first-filter first resonator that sustains propagation of correctly oriented in-band RF, coupling in-band RF out of said first first-filter resonator and into a subsequent first-filter resonator.

13. The waveguide directional filter and/or combiner of claim 11, wherein each of said plurality of successive first-filter resonators further comprises:

a first first-filter, successive-resonator iris, coupling correctly oriented in-band RF from a previous first-filter resonator into said successive first-filter resonator, which iris is also the resonator output iris from the immediately preceding resonator; and

a second first-filter, successive-resonator iris, interacting with said first first-filter, successive-resonator iris, a set of first-filter, successive-resonator tuning probes, and a cavity structure of said first-filter, successive-resonator filter section to form a next successive first-filter resonant chamber that sustains propagation of correctly oriented in-band RF, thereby coupling the in-band RF out of the immediately preceding first-filter resonator and into the next succeeding first-filter resonator.

14. The waveguide directional filter and/or combiner of claim 11, wherein the final first-filter resonator further comprises:

a first-filter, final-resonator input iris coupling correctly oriented in-band RF from the immediately preceding first-filter resonator into said final first-filter resonator, which iris is also the resonator output iris from the immediately preceding first-filter resonator; and

a first-filter, final-resonator output iris in said first-filter, final-resonator baffle, interacting with said first-filter, final-resonator input iris, the preceding first-filter resonators, and a cavity structure of said first waveguide filter to form a final first-filter resonant chamber that couples correctly oriented in-band RF into said second rectangular waveguide section.

15. The waveguide directional filter and/or combiner of claim 1, wherein said second elliptic filter section further comprises:

a first second-filter resonator receiving RF from said first rectangular waveguide section and passing the received RF to the next second-filter resonator;

a plurality of successive second-filter resonators, each receiving RF from the previous second-filter resonator and passing the received RF to the next second-filter resonator; and

a final second-filter resonator, receiving RF from the previous second-filter resonator and passing the received RF to the second rectangular waveguide section.

16. The waveguide directional filter and/or combiner of claim 15, wherein said second resonator further comprises:

a second-filter, first-resonator input baffle restricting propagation of RF from said first rectangular waveguide section into said second waveguide filter section;

a first-resonator input iris in said second-filter input baffle, permitting in-band RF energy in the frequency range of the waveguide directional filter

and/or combiner, and oriented in the direction permitted by the aperture, to propagate into said second waveguide filter section;

a second-filter, first-resonator output baffle; and

a second-filter, first-resonator output iris in said second-filter, first-resonator output baffle, interacting with said first second-filter, first-resonator input baffle, said second-filter, first-resonator input iris, a set of second-filter, second-resonator tuning probes, and a cavity structure of said second waveguide filter section to form a second-filter first resonator that sustains propagation of correctly oriented in-band RF, coupling in-band RF out of said first second-filter resonator and into a subsequent second-filter resonator.

17. The waveguide directional filter and/or combiner of claim 15, wherein each of said plurality of successive second-filter resonators further comprises:

a first second-filter, successive-resonator iris, coupling correctly oriented in-band RF from a previous second-filter resonator into said successive second-filter resonator, which iris is also the resonator output iris from the immediately preceding resonator; and

a second second-filter, successive-resonator iris, interacting with said first second-filter, successive-resonator, a set of second-filter, successive-resonator tuning probes, and a cavity structure of said second waveguide filter section to form a next successive second-filter resonant chamber that sustains propagation of correctly oriented in-band RF, thereby coupling the in-band RF out of the immediately preceding second-filter resonator and into the next succeeding second-filter resonator.

18. The waveguide directional filter and/or combiner of claim 15, wherein the final second-filter resonator further comprises:

a second-filter, final-resonator input iris coupling correctly oriented in-band RF from the immediately preceding second-filter resonator into said final

second-filter resonator, which iris is also the resonator output iris from the immediately preceding second-filter resonator; and

a second-filter, final-resonator output iris in said second-filter, final-resonator baffle, interacting with said second-filter, final-resonator input iris, the preceding second-filter resonators, and a cavity structure of said second-filter final resonator to form a final second-filter resonant chamber that couples correctly oriented in-band RF into said second rectangular waveguide section.

19. The waveguide directional filter and/or combiner of claim 1, wherein said directional filter and/or combiner may function as a combiner, that is, said directional filter and/or combiner may be fed with two RF input signals on two of its ports assigned as input ports, of which input signals one is an in-band RF signal and the other an out-of-band RF signal of such frequency as to be carried with low attenuation by the waveguides comprising said directional filter and/or combiner, as a consequence of which both the in-band and the out-of-band RF signals will be present at a single output port of said directional filter and/or combiner.

20. The waveguide directional filter and/or combiner of claim 1, wherein said directional filter and/or combiner may function as a separator, that is, said directional filter and/or combiner may be fed with an RF input signal, itself comprised of a plurality of RF signals, on one of its ports assigned as an input port, of which component RF input signals one is an in-band RF signal with respect to said directional filter and/or combiner and the remainder out-of-band RF signals of frequencies carried with low attenuation by the waveguides comprising said directional filter and/or combiner, as a consequence of which the in-band RF signal will be present at one output port of said directional

filter and/or combiner and the out-of-band RF signals will be present at a second output port of said directional filter and/or combiner.

21. An apparatus for filtering RF signals, comprising:

first means for guiding an RF broadcast signal along a path with a conductive boundary, along which path the signal can propagate;

first means for directing a component of the RF broadcast signal within a specific frequency range and a specific phase orientation along a path at right angles to the first conductively-bound path, wherein the in-band, rolloff, and out-of-band characteristics of the first means for directing correspond to those of an elliptic filter;

second means for guiding the remnant RF broadcast signal further along the initial path;

second means for directing an RF broadcast signal component at the same frequency as but out of phase with respect to the RF broadcast signal component directed by the first means for directing, wherein said second means for directing directs the RF signal component that was out of phase with respect to and unable to be directed by said first means for directing, and wherein the in-band, rolloff, and out-of-band characteristics of the second means for directing correspond to those of an elliptic filter;

third means for guiding the out-of-band energy of the RF broadcast signal along a further path exiting the apparatus;

means for rejoining the specific RF broadcast signal components back together in the their original phase relationship; and

fourth means for guiding the rejoined RF broadcast signal components along a further path out of the apparatus.

22. A method for filtering, combining, and separating RF signals, comprising the following steps:

admitting an RF broadcast signal into a first portal waveguide;

propagating the RF signal along the first portal waveguide;

admitting any in-band RF signal energy at a first phase angle from the RF broadcast signal into a first elliptic filter;

further propagating the RF signal along a continuation of the first portal waveguide for a distance approximating an odd number of quarter wavelengths of the in-band component of the RF signal;

admitting from the RF broadcast signal into a second elliptic filter any in-band RF signal energy out of phase with respect to the RF signal energy admitted into the first filter;

passing any RF broadcast signal energy admitted into neither filter out the end of the first portal waveguide;

collecting the in-band RF signal energy passed through either elliptic filter into a second portal waveguide with a geometry that restores the original phase relation of the in-band RF signal components; and

passing the recombined in-band RF signal energy out of the end of the second portal waveguide.